Dispersal of desert and montane plants (including pine) by animals

Jenny Briggs, Steve Vander Wall, Bill Longland, Jennifer Hollander and Maurie Beck

Dept. of Biology, A.R.S. and Biological Resources Research Center

UNIVERSITY OF NEVADA, RENO

Featured species

1. Jeffrey pine (E. Sierra) – J. Briggs and S. Vander Wall
2. Pinyon pine (Pine Nut Range) – J. Hollander
3. Bitterbrush (Gt. Basin/E. Sierra) – S. Vander Wall
4. Desert peach (Pine Nuts/Gt. Basin) – M. Beck
5. Indian ricegrass (Gt. Basin) – B. Longland et al.)
6. (Joshua tree– Mojave region– T. Esque?)

Benefits of dispersal

(Howe and Smallwood 1982, Wenny 2001)

Escape hypothesis-

avoid density-dependent mortality near parent

Colonization hypothesis-

access new or far habitats

Directed dispersal hypothesis-

reach sites where survival is disproportionately high

Components of dispersal

Quantity

- # of seeds, # of sites

- # of dispersers, visits

Quality

-type of microsite

-means of burial/ deposition

-handling effect

(Schupp 1993)

Quantity

Larderhoard

Scatterhoard

Qualtity

Microsites for seeds

- Substrate
- Understory *
- Overstory

--*Depth*

--*Size of cache*

Nutrients

Shade

Moisture

Biotic risks

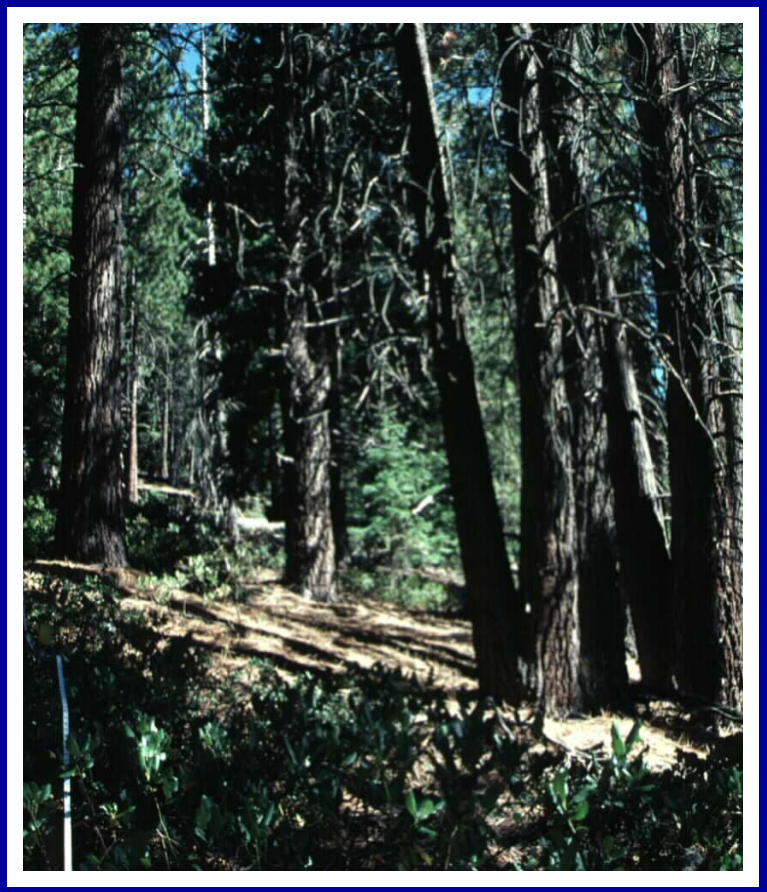
1. Jeffrey pine: two-phase dispersal

Animals consume and cache wind-dispersed seeds

Vander Wall 1992-2002

Jeffrey pine

Evidence of caches in all age classes



What do common forest rodent species do with Jeffrey pine seeds ?

Hypotheses: They cache in ‘preferred’ microsites

Mean cache size/depth vary with species

Methods

-15+ animals of 4 species

-150 radio-labeled pine seeds

-10 x 10m field enclosures

Chipmunks

T. quadrimaculatus

T. amoenus

Deer mouse

Peromyscus maniculatus

Ground Squirrel

Spermophilous lateralis

Methods

-Found caches with Geiger counter

-Recorded microsite characteristics

-Mapped random points for comparison

Cache site preferences- results for all animals

1* Mineral soil under shrubs

2 Light litter under shrubs

3* Mineral soil in open

4* Light litter in open

5 Heavy litter in open

($P < 0.05$, compositional analysis)*

2. Piñon pine

Hollander and Vander Wall, 2003. Oikos.

6 potential rodent dispersers

Don Baccus

Least chipmunk

(*Tamias minimus)*

Charlie Ott

White-tailed antelope ground squirrel

(*Ammospermophilus leucurus)*

Great basin pocket mouse
(*Perognathus parvus*)

Panamint kangaroo rat

(*Dipodomys panamintinus*)

Piñon mouse

(*Peromyscus truei*)

and again : Deer mouse

(*Peromyscus maniculatus*)

% seeds harvested and cached

(means for 5 animals per species)

Species	Harvested	Scatterhoarded	Larderhoarded
Piñon mouse	98.0	58.6	3.4
Deer mouse	90.4	44.6	0.0
Least chipmunk	97.0	64.2	0.0
Ground squirrel	100.0	60.8	0.0
Kangaroo rat	94.4	53.8	12.6
Pocket mouse	99.8	31.0	37.6

Why is this relevant ?

DIFFERENTIAL GERMINATION!

Least chipmunk cache
8 mm deep, 2 seeds

Kangaroo rat cache
22 mm deep, 14 seeds

Ground squirrel cache
16 mm deep, 3 seeds

Seedlings need shrub cover to survive >1 yr...?

3. Desert peach (Prunus anderssoni)

Beck unpubl. data 99-02

Results of desert peach caching trials

Means of 12 trials (=14 animals total); 200 nuts/trial at "source shrubs"

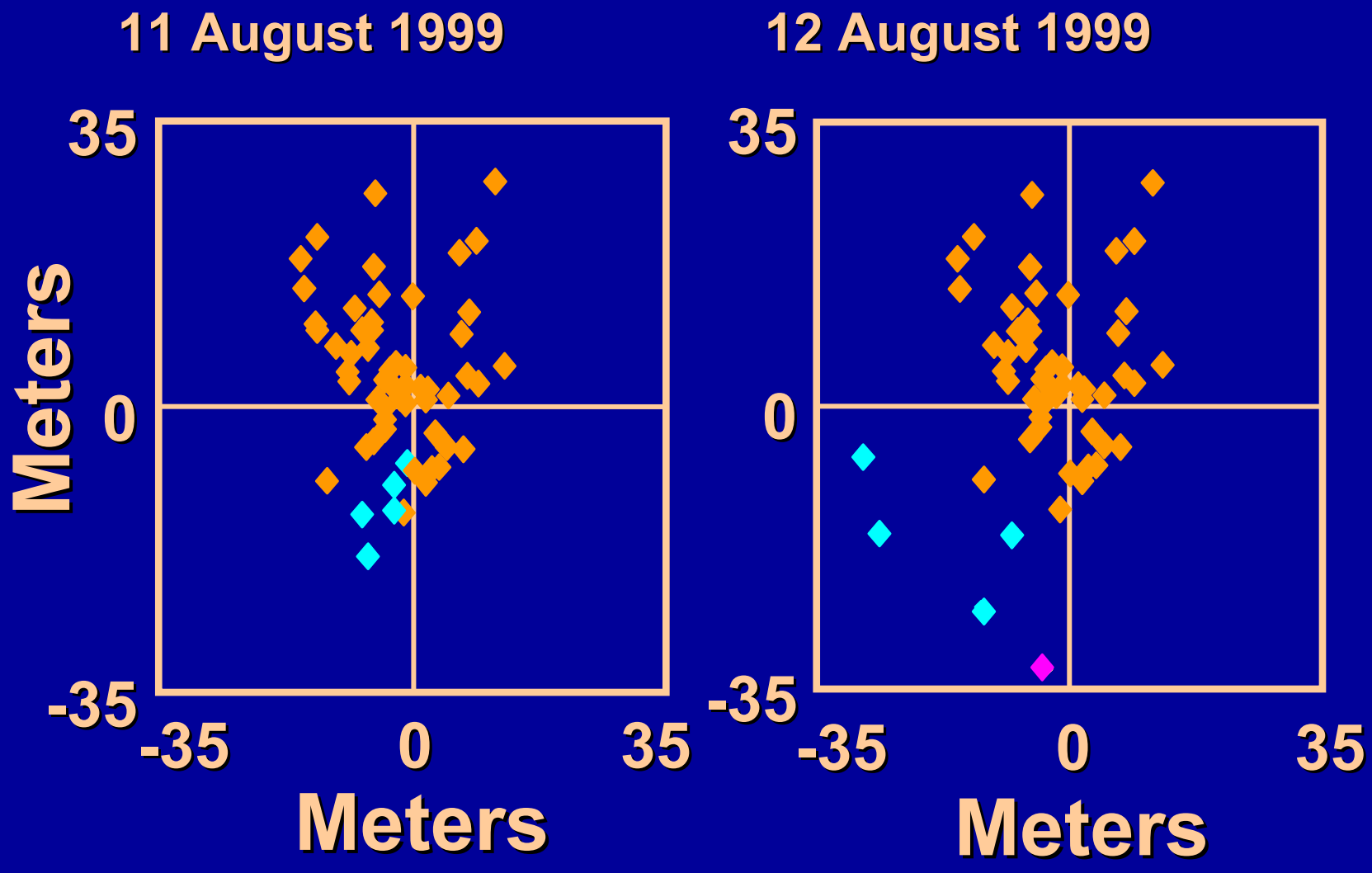
97.6 % harvested

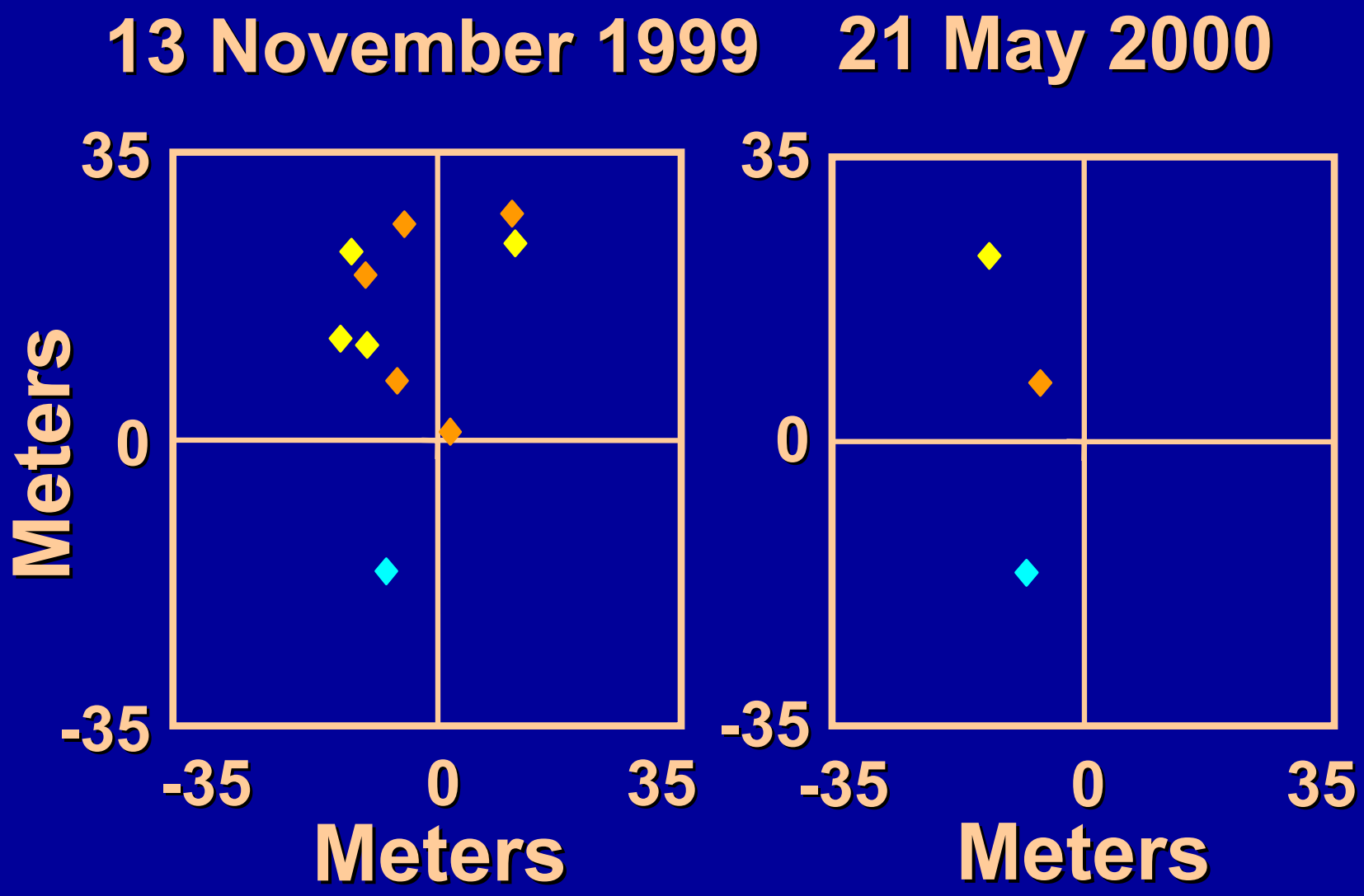
6.5 % eaten

43.9 % larder-hoarded

37.5 % scatter-hoarded

Dynamics of Desert Peach caches!




13 November 1999
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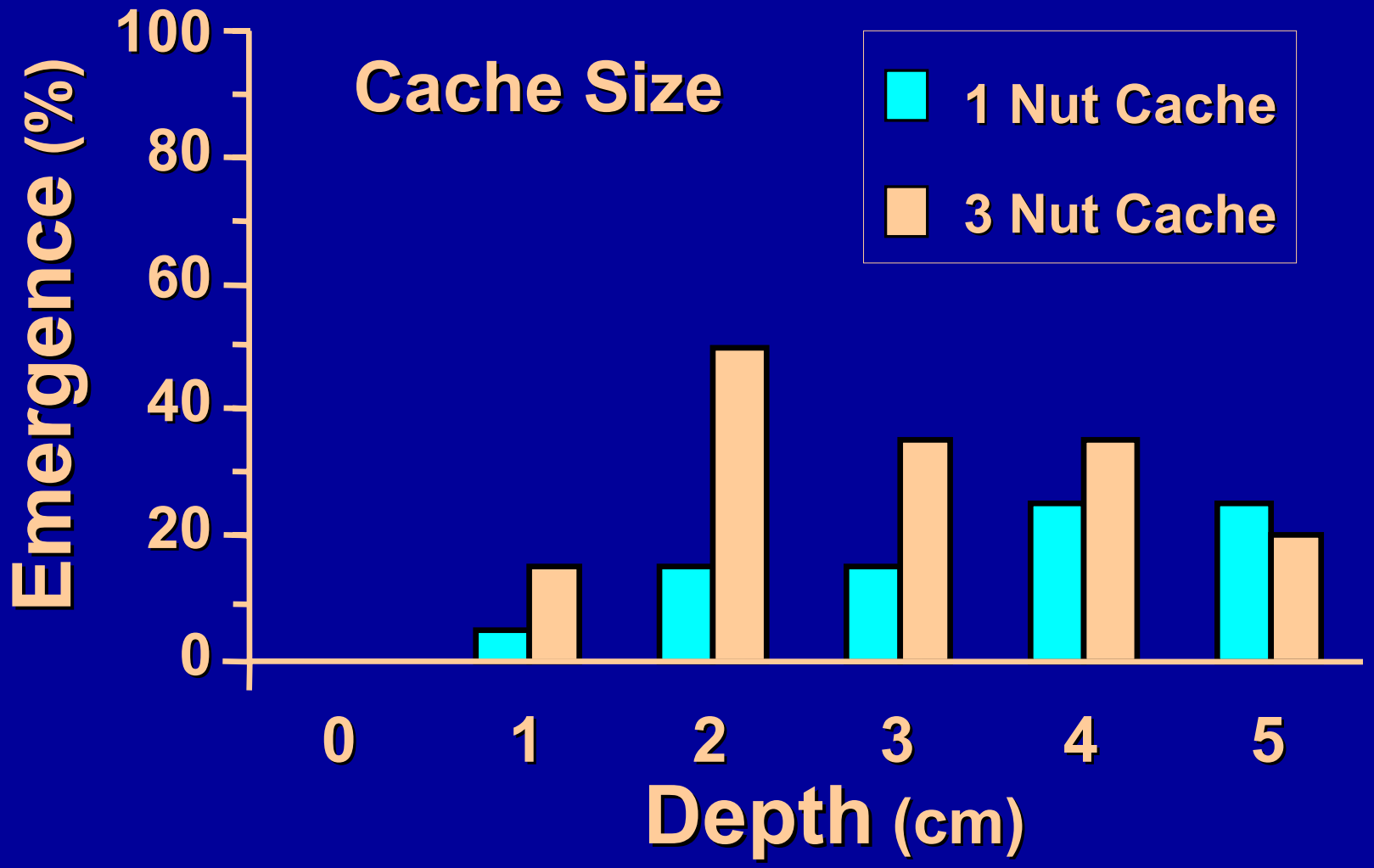
Emergence of Desert Peach, 00



4. Indian ricegrass
(Oryzopsis hymenoides)

Longland et al 2001. Ecology.

SEEDLING RECRUITMENT AT HOT SPRINGS MOUNTAINS, 1995-96

Initial Caching	Rodents	Ants	Treatment	Mean (±SE) Number of Seedlings from: Scatter-hoards	Singles	Ant larders	Larder-hoards
No	Yes	Yes	Control	21.1 (17.7)	1.4 (1.2)	0	0
No	No	No	1	0	29.2 (12.3)	0	0
No	Yes	Yes	2	12.3 (6.9)	2.5 (2.5)	0.5 (0.5)	0
No	No	Yes	3	14.0 (12.5)	26.7 (12.7)	1.3 (1.2)	0
No	Yes	No	4	54.2 (30.0)	2.0 (0.8)	0	0.2 (0.2)
Yes	No	No	5	589.3 (147.5)	1.7 (1.0)	0	0
Yes	Yes	Yes	6	51.0 (33.1)	2.2 (2.2)	0.2 (0.2)	0
Yes	No	Yes	7	9.3 (4.0)	4.2 (2.2)	0	0
Yes	Yes	No	8	27.8 (14.0)	0.8 (0.8)	0	0
Yes (Cache-maker exclusion)	Yes	No	9	34.5 (16.2)	0.2 (0.2)	0	0

5. Antelope bitterbrush
(montane and desert sites)

Vander Wall 1994. Ecology

Results of bitterbrush caching trials

Means of 4 trials (= ? animals total); 600 seeds/trial at "source shrubs"

98.0 % harvested

14.6 % eaten

? % larder-hoarded

57.7 % scatter-hoarded

Summary: recruitment from caches

	% caches (of all initial seeds)	% seedlings from surface seeds	% of all NEW seedlings at site
Bitterbrush	1.1-2.4	< 0.3	> 99
Indian ricegrass	(1.5 x surface recruitment)		88.4
Desert peach	2.5	?	"most"
Jeffrey pine (art.)	45.1	4.7	N.A.
Pinyon pine (art.) (1 yr survival)	46.5	0	N.A.

Implications for restoration

-- Present supplemental “target” seeds

-- After caching, introduce “decoy”/sacrifice seeds

→Limited retrieval of target caches

•Factors:

-- Precipitation

-- Relative pop. sizes of dispersers/consumers/pathogens

-- Economics

(Longland and Bateman 1998, J. Range Mgmt)

Costs/benefits

- Variable environment →episodic recruitment at best

- Uncertain outcomes

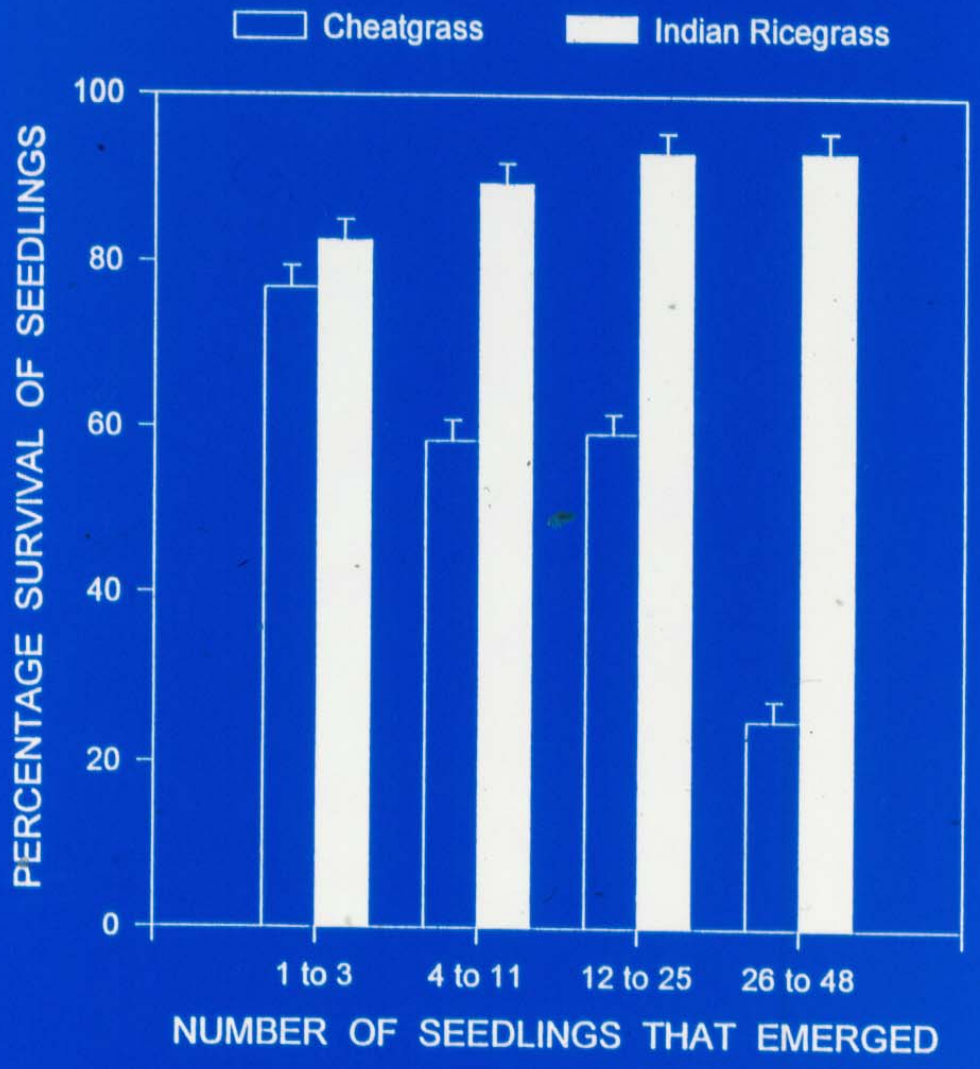
- Choice and impacts of decoy?

+ Mimics natural masting→predator satiation

+ Less $ and labor than drill-seeding ("buffet lines")

+ Access to distant/unstable sites

Longland + Bateman (98),
Vander Wall + Borchert (03)


Cheatgrass
Indian Ricegrass
PERCENTAGE SURVIVAL OF SEEDLINGS
100
80
60
40
20
0
1 to 3
4 to 11
12 to 25
26 to 48
NUMBER OF SEEDLINGS THAT EMERGED